PLANAR

EL640.480-AF1 Family
6.4" Electroluminescent VGA Flat Panel Display

USER'S MANUAL

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Revision Control

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EL640.480-AF1 VGA Display

This manual describes the Planar ICEBrite EL640.480-AF1 family of displays. This 6.4" diagonal VGA product offers dramatic visual improvements over passive LCDs.

Utilizing Planar's proprietary ICEBrite (Integrated Contrast and Brightness Enhancement) technology, this display excels in ambient light environments ranging from dark to nearly sunlight-bright. This technology achieves very high contrast and exceptionally clear images. This display utilizes an 8-bit FPD-type interface compatible with most passive LCD video controller chips, making it easy to integrate and to replace existing LCD displays.

Through simple design and advanced manufacturing technologies, Planar's new VGA display family brings the visual performance and image quality of EL into cost-sensitive applications that have up to now been limited by the performance of LCD displays.

Features and Benefits

Excellent visual performance:
- High brightness and contrast
- Wide viewing angle

Significant reduction in cost over previous EL technology

Reliable, long operating life

Extremely rugged and durable

Low EMI emissions

Rapid display response

Low power design

Options

Anti-glare, conformal coating, and extended temperature options are available on this display.

The anti-glare option adds an anti-glare film to the front of the display to reduce specular reflections (see Application Note 135 for more information).

The conformal coating option adds a protective layer to the display for applications in which the display may be subjected to high humidity, dust, or salt mist (see Application Note 122 for more information).

The extended temperature (ET) option provides a -40 to 85C operating temperature range, analog dimming capability, and a locking input connector.

Installation and Handling

The mechanical package consists of the display panel and electronic circuit board adhesively bonded together and mounted in a plastic bezel. The bezel supplies the mounting ears and protects otherwise exposed leads. The display is made of glass material and must be handled with care.

CAUTION: The display uses CMOS and power MOSFET devices. These components are electrostatic sensitive. Unpack, assemble, and examine this assembly in a static-controlled area only. When shipping, use packing materials designed for protection of electrostatic-sensitive components.

Do not drop, bend or flex the display. Do not allow objects to strike the surface of the display

Mounting

The AF1 display was designed to facilitate the mounting of optical treatments and touch screens on the viewing side of the display. To this end, the glass extends in front of the mounting bezel by approximately 0.5 mm (0.02") It is imperative that any mounting scheme apply uniform pressure across the glass at all times. Pressure applied only to the corners or edge of the glass is likely to cause breakage.

Mounting should be done using the mounting ears only. Use either metric M3 screws tightened to 350 Ncm maximum, or unified #4 screws tightened to 4.7 in/lb maximum.

CAUTION: Properly mounted, this display can withstand high shock loads and severe vibration in aggressive environments. However, the glass panel used in this display will break when subjected to bending stresses, high impact, or excessive loads.

To prevent injury in the event of glass breakage, a protective overlay should be used on the viewer side of the display.

WARNING: These products generate voltages capable of causing personal injury (high voltage up to 230 V_{ac}). Do not touch the display electronics during operation.

Cleaning

As with any glass or coated surface, care should be taken to minimize scratching. Clean the display glass with mild, water-based detergents only. Apply the cleaner sparingly to a soft cloth, then wipe the display. Disposable cleaning cloths are recommended to minimize the risk of inadvertently scratching the display with particles embedded in a re-used cloth.

The TAB (tape-automated bonding) leads between the electronics and the display glass are very sensitive to handling. When cleaning the edges of the display glass, special care should be taken not to damage the leads.

Cable Length

Do not exceed the maximum cable length of 600 mm (24 in.). Longer cables may cause data transfer problems between the data transmitted and the display input connector. Excessive cable lengths can pick up unwanted EMI. There are third party products which allow this maximum cable length to be exceeded. Contact Planar Application Engineering for more information.

Avoiding Burn-In

As with other light emitting displays, displaying fixed patterns on the screen can cause burn-in, where luminance variations can be noticed. Use a screen saver or image inversion to avoid causing burn-in on the display.

Specifications

Control Basics

The EL panel is a matrix structure with column and row electrodes arranged in an X-Y formation. Light is emitted when an AC voltage of sufficient amplitude is applied at a row-column intersection. The display operation is based on the symmetric, line at a time data addressing scheme. Required operating voltages are provided by an integrated DC/DC converter.

Unless otherwise specified, performance characteristics are guaranteed when measured at 25°C.

Power

The supply voltages are shown in Table 1. All internal high voltages are generated from the display supply voltage (V_H). The logic supply voltage (V_L) should be present whenever video input signals or V_H is applied. The minimum and maximum specifications in this manual should be met, without exception, to ensure the long-term reliability of the display. Planar does not recommend operation of the display outside these specifications.

Table 1. DC Input Voltage Requirements.

	AF1	Notes
V_L	+5 V ±5%	absolute max 7.0 V
V_H	+12 V ±10%	absolute max 15 V
I_L, max	75 mA	@ V_L = +5 V
I_H, max	.7 A	@ V_H = +12 V
Ptyp, 120 Hz	4.5 W	3840 'E' characters
Pmax, 120 Hz	8.4 W	50/50 2x2 checkerboard

CAUTION: Absolute maximum ratings are those values beyond which damage to the device may occur.

Table 2. Video Input Requirements.

Description	Min	Max	Units	Notes
Video logic high voltage	3.9	5.0	V	All input thresholds are CMOS
Video logic low voltage	0	0.9	V	Video lines have 100 Ω series resistors
Video logic input current	–	±10	µA	

CAUTION: There is no overcurrent protection on either the V_H or V_L inputs to protect against catastrophic faults. Planar recommends the use of a series fuse on the 12 volt supply. A general guideline is to rate the fuse at 1.8 to 2 times the display maximum current rating.

Connectors

The video/power connector,is J1: a 20-pin, 2mm pitch connector (Figure 1).

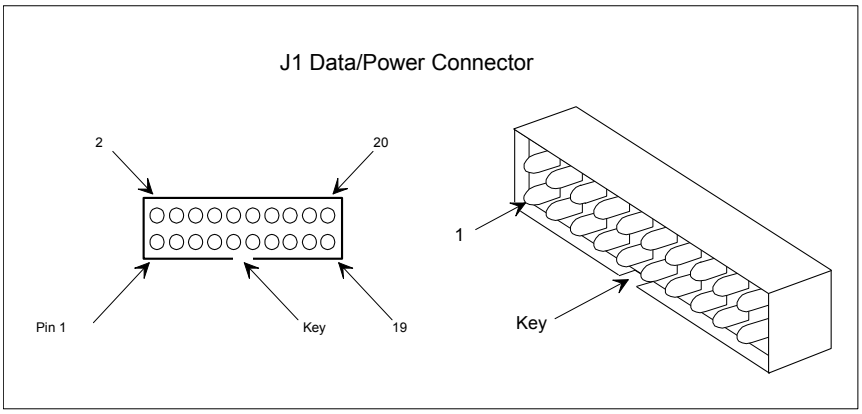


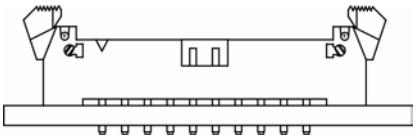
Figure 1. J1 Connector Pinouts.

The non-ET version display uses the Samtec STMM-110-01-T-D or equivalent connector matching the pinouts in Table 3. The mating connector is in the Samtec TCSD family of cable strips. The proper connector, user-specified cable length, and connector configuration are supplied as a single unit from Samtec. Consult your Samtec representative (1 800-SAMTEC9) for the cable/connector options.

Table 3. J1 Connector Pinouts.

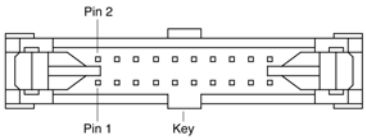
Pin	Signal	Description	Pin	Signal	Description
1	UD1	Video data (upper)	2	UD0	Video data (upper)
3	UD3	Video data (upper)	4	UD2	Video data (upper)
5	LD1	Video data (lower)	6	LD0	Video data (lower)
7	LD3	Video data (lower)	8	LD2	Video data (lower)
9	CP2	Data input clock	10	GND	Ground
11	CP1	Input data latch	12	GND	Ground
13	S	Scan start-up signal	14	GND	Ground
15	GND	Ground	16	GND	Ground
17	V_L	+5 V Power	18	V_L	+5 V Power
19	V_H	+12 V Power	20	V_H	+12 V Power

Locking Power/ Data Connector, ET Version Only



A locking connector is present at J1on the Extended Temperature (ET) version display.

The mating connector is the Samtec TCSD family of cable strips. Compatibility with non-Samtec equivalents should be verified before use.



Dimming Connector J2, ET Version Only

The dimming connector is a JST part number B2B-PH-K-S, which is a 2-pin, 2 mm, header. The recommended mate is a JST part number PHR-2 (housing) with JST part number SPH-004T-P0.5S (crimp for 28-34 AWG wire). JST can be contacted at 866-578-3111.

For a discussion of the dimming feature, refer to the Dimming section below, under Optical Performance.

Interfacing

This dual scan LCD-type video interface provides a low cost, flexible method for controlling display brightness and power consumption. Many off-the-shelf chipsets are available for interfacing to flat panel displays. If your application does not require chip-level integration, there are many vendors that can supply board-level solutions for serial control, PC104, ISA, and many other interfaces.

Planar Application Note 116 summarizes some of the interfacing options that have been used in the past with EL VGA displays.

Video Input Signals

The end of the top line of a frame is marked by S, scan start up signal as shown in Figure 2. The end of each row of data is marked by CP1 as shown in Figure 2 and Figure 3.

Input signals **UD0** through **UD3** contain the video data for the upper screen and signals **LD0** through **LD3** contain the data for the lower screen. For example, four pixels (UD3—UD0) are sent to row 1 at the same time as four pixels (LD0—LD3) are sent to row 241. This results in eight pixels sent on each cycle of video clock **CP2**. Pixel information is supplied from left to right and from top to bottom. Video data for one row is latched on the fall of **CP1** (Figure 4).

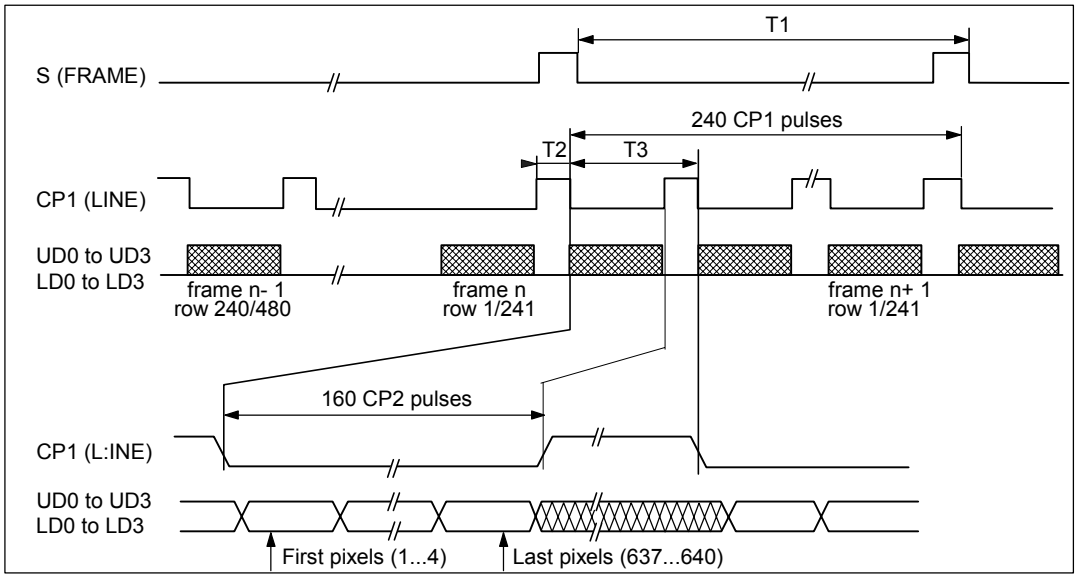


Figure 2. Video Input Timing Diagram.

Table 4. Video Input Timing.

Symbol	Name	Min	Max	Units
T1	Frame time	8.3	---	ms
	Frame frequency	---	120	Hz
T2	CP1 High time	60	---	ns
T3	CP1 Period	34.5	---	µs

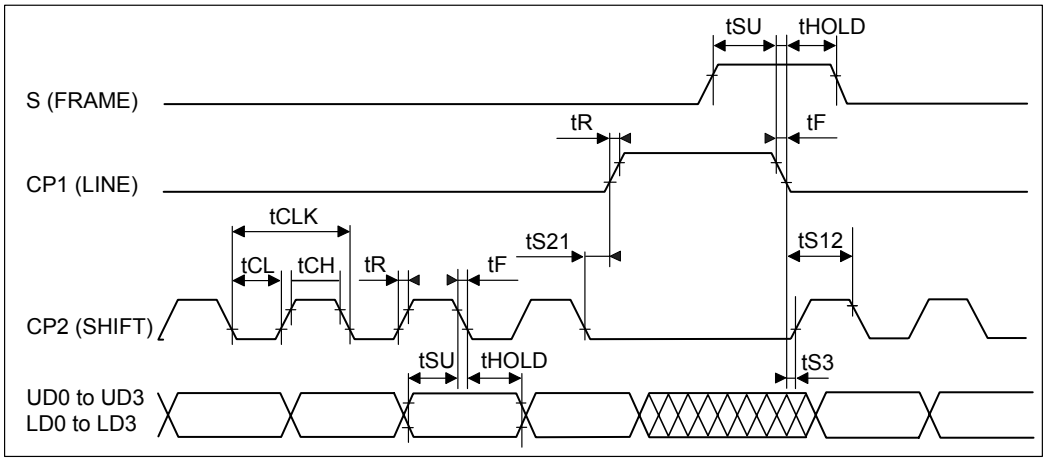


Figure 3. Setup and Hold Timing Diagram.

Table 5. Setup and Hold Timing.

Symbol	Name	Min.	Max	Unit
tS21	CP1 allowance from CP2	0		ns
tS12	CP2 allowance from CP1	200		ns
tS3	CP1 allowance to CP2	50		ns
tSU	Setup time	50		ns
tHOLD	Hold time	40		ns
tR	Rise time		30	ns
tF	Fall time		30	ns
tCLK	CP2 clock cycle	154		ns
tCL	CP2 clock low time	60		ns
tCH	CP2 clock high time	60		ns

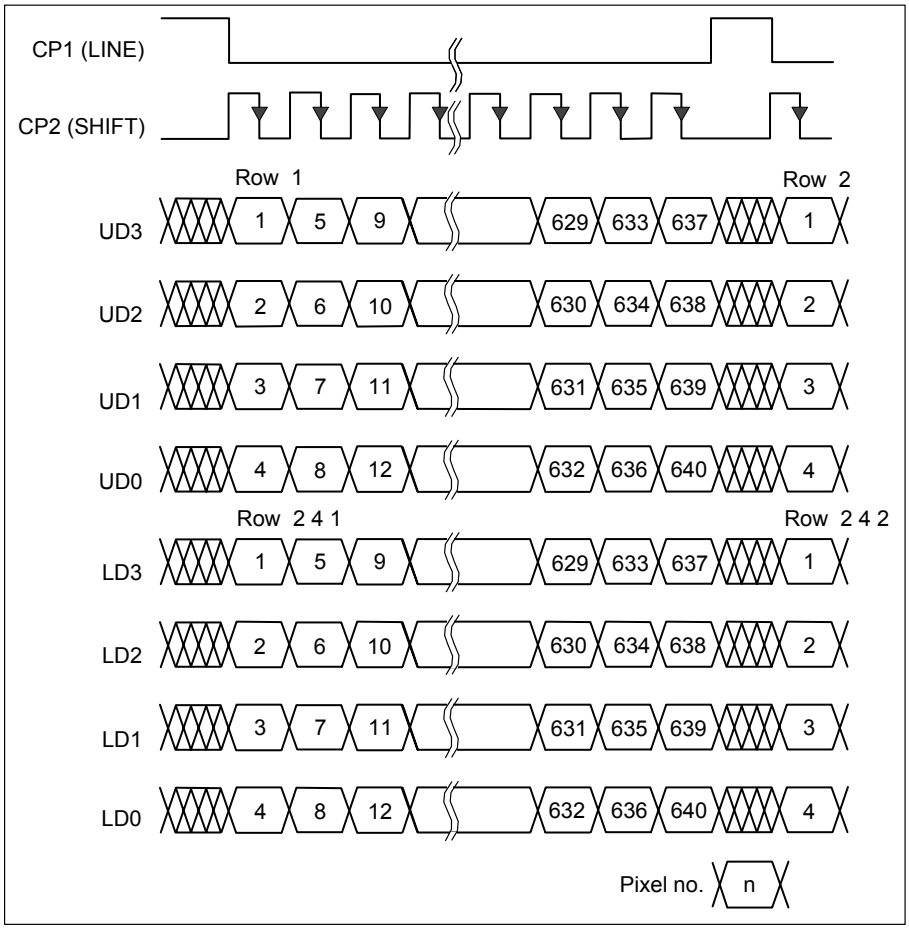


Figure 4. Data Format.

Self-Test Mode

The display incorporates a self-test mode composed of a 1x2 checkerboard pattern that inverts and alternates with an all pixels on pattern. The self-test mode is entered by applying power to the display with the **S** signal static. The display remains in this mode until two (2) low-to-high transitions of the **S** signal are detected. The display then enters and remains in normal (user video driven) operation as long as power is applied. To enter self-test mode again, the display must be reset by cycling the V_H power input.

Optical

Table 6. Optical Characteristics.

Luminance		
L_{on} (areal), min	40.0 cd/m²	Screen center, 120 Hz frame rate
L_{on} (areal), typ	65.0 cd/m²	Screen center, 120 Hz frame rate
L_{off} (areal), max	0.2 cd/m²	Center and four corners
Non-uniformity		
All pixels fully lit	35%	Maximum difference two of five points, using the formula: LNU%=[1- (min_lum/max_lum)] x 100%
Luminance Variation (Temperature)		
Maximum	15%	Across operating temperature range
Luminance Variation (Time)		
Maximum	20%	10,000 hours at 25°C ambient
Viewing Angle		
Minimum	160°	
Contrast Ratio		
Minimum	19:1	@ 500 lux ambient, 120 Hz frame rate
Typical	50:1	

Dimming

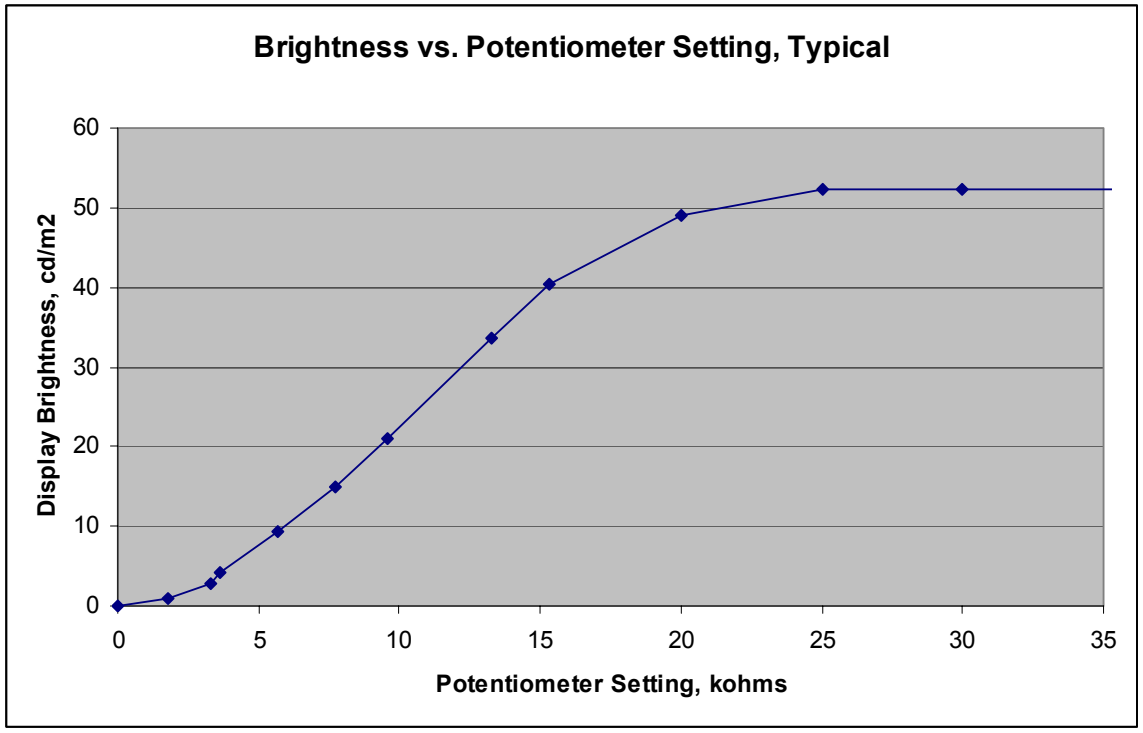
The scan rate dimming feature allows the brightness of the display to be lowered proportionally by reducing the scan rate. Scan rate dimming is performed within the application by lowering the scan rate of the video input signals (i.e., lowering the frequency of the S signal.) Because brightness is proportional to scan rate, the display can be dimmed by adding pauses between every horizontal period. For maximum brightness, the S signal frequency should be set to the maximum of 120 Hz.

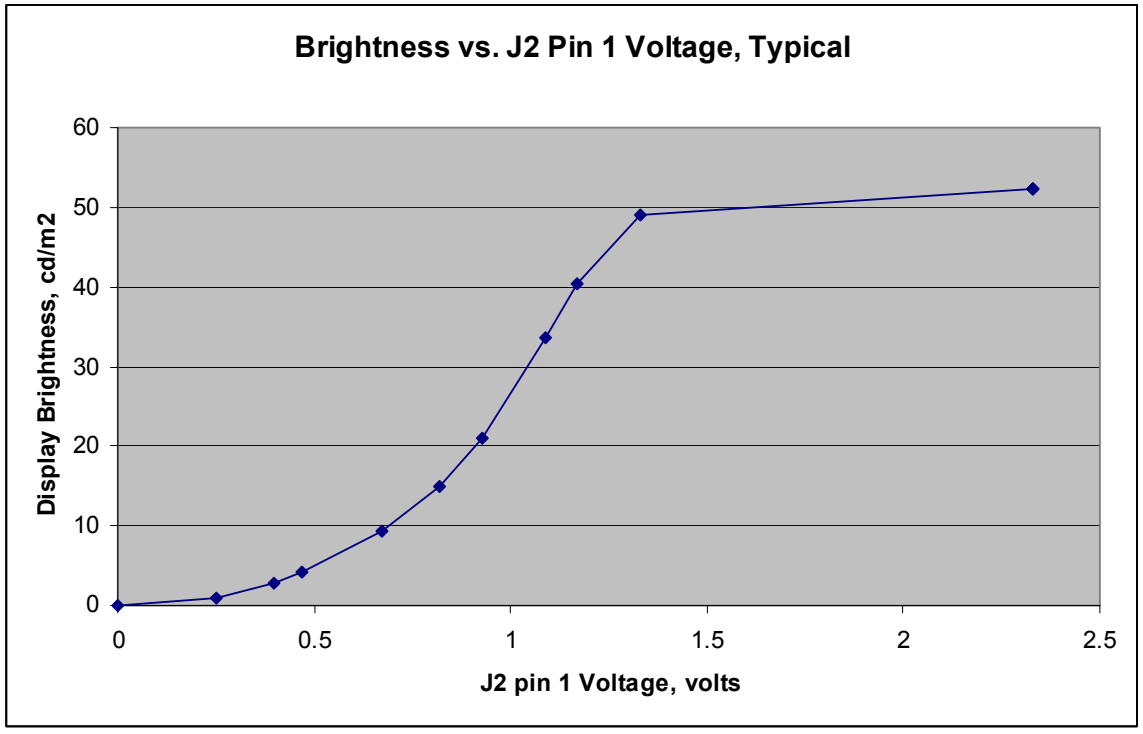
The lowest useable frame rate (brightness) is dependent on the perceived flicker of the displayed image, but will most likely be around 60 Hz. For more information on scan/frame rate dimming please see Planar Application Note 120.

Analog dimming control circuitry is present on the ET display model. This feature allows manual analog dimming of the brightness from 100% to approximately 0% (dark) of the full brightness.

To utilize analog dimming, connect one end of a 50k ohm external potentiometer to pin 2 of connector J2 and connect the wiper of the potentiometer to pin 1. With 50k across the dimming connector the display brightness will be at maximum. Decreasing the resistance will decrease the display brightness immediately. Alternatively, an external voltage or current mode D/A converter may be used to facilitate dimming by sinking a maximum of 100 µA (for maximum dimming) from pin 1 to pin 2 of the dimming connector.

See the following graphs for typical analog dimming performance:





Generating Grayscales

Some applications may benefit by using grayscales. The AF1 has a maximum frame rate frequency of 120 Hz. Using the higher frame rate, combined with

flat panel controllers designed for this faster display, it is possible to generate usable grays through frame rate control and dithering. Video controllers from manufacturers such as C&T and Epson use these methods with proprietary algorithms to generate grayscales.

The response time of ICEBrite displays is much faster than LCDs, therefore not all possible grayscales generated by the video controller are actually usable. Many of the grayscales may flicker or swim. Careful testing is necessary to select appropriate grayscales for an application, especially when the ICEBrite displays are driven at less than their maximum frame rate.

For additional information, refer to Planar Application Note 119 or contact Planar's Application Engineers.

Reliability

The MTBF (mean time between failure) is a minimum of 50,000 hours at 25°C ambient, except for performance characteristics with an otherwise specified life expectancy.

Safety and EMI

The display will not inhibit the end product from obtaining these certifications:

Safety	UL544, IEC950
EMI	FCC Part 15/J, Class B EN55022 Level B

Environmental

Table 7. Environmental Characteristics.

Temperature		
Operating	-5 to +55°C	
Operating (ET version)	-40 to +85°C	
Non-Operating	-40 to +75°C	
Non-Operating (ET)	-40 to +95°C	
Operating Survival	-20 to +65°C	
Operating Survival (ET)	-40 to +85°C	
Humidity		
Non-condensing	93% RH max, @ 40°C	per IEC 68-2-3.
Altitude		
Operating	0 to 5 km (16k ft)	per IEC 68-2-13.
Non-Operating	0 to 18 km (58k ft)	
Vibration		
Random	0.05 g^2/Hz	ASD level, 20-500 Hz per IEC 68-2-36, test Fdb
Shock		
Half sine wave	100 g, 4 ms	18 (3 each, 6 surfaces) per IEC 68-2-27, test Ea

Mechanical Characteristics

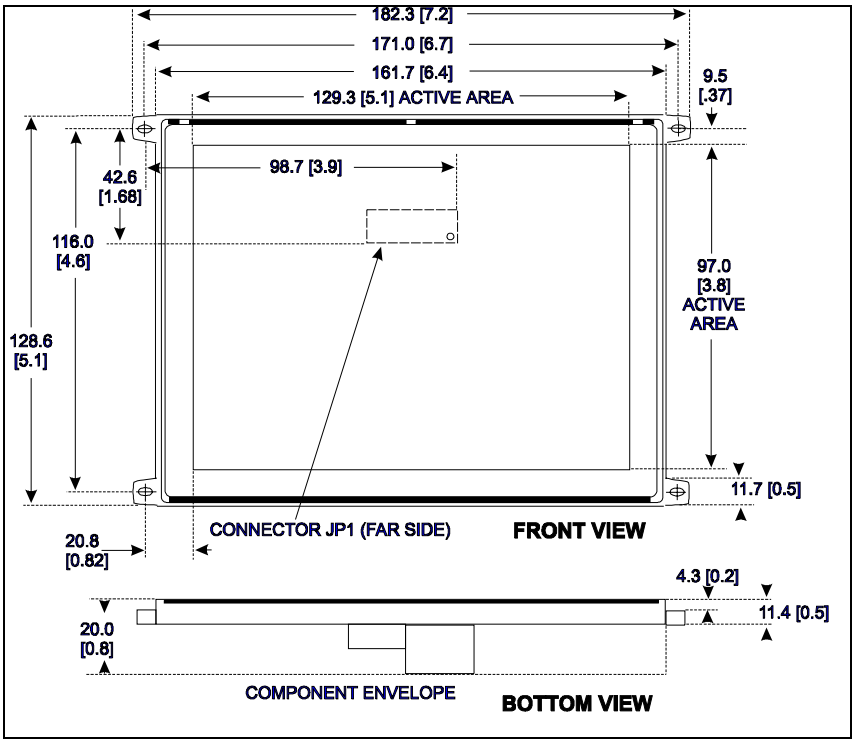
Table 8. Weight and Dimensions

Weight (maximum)	300 g
Display Size	182.3 x 128.6 (W x H)
Display Depth	20.0
Active Area	129.3 x 97.0 (W x H)
Fill Factor	58%
Pixel Pitch	.202 x .202 (W x H)
Pixel Size	.154 x .154 (W x H)

All dimensions (except weight) are in mm.

Component Envelope

Figures 5 illustrates the distance components extend behind the display. Tall components do not necessarily fill this area. Planar reserves the right to relocate components *within the constraints of the component's envelope* without prior customer notification. For this reason, Planar advises users to design enclosure components to be outside the component envelope.



Dimensions in are millimeters; inches in brackets.
Tolerances unless otherwise stated, ±0.2 mm
Connector is shown from the back side.

Figure 5. EL640.480 AF1 Dimensions.

Description of Warranty

Seller warrants that the Goods will conform to published specifications and be free from defects in material for 12 months from delivery. To the extent that Goods incorporate third-party-owned software, Seller shall pass on Seller's licensor's warranty to Buyer subject to the terms and conditions of Seller's license.

Warranty repairs shall be warranted for the remainder of the original warranty period. Buyer shall report defect claims in writing to Seller immediately upon discovery, and in any event, within the warranty period. Buyer must return Goods to Seller within 30 days of Seller's receipt of a warranty claim notice and only after receiving Seller's Return Goods Authorization. Seller shall, at its sole option, repair or replace the Goods.

If Goods were repaired, altered or modified by persons other than Seller, this warranty is void. Conditions resulting from normal wear and tear and Buyer's failure to properly store, install, operate, handle or maintain the Goods are not within this warranty. Repair or replacement of Goods is Seller's sole obligation and Buyer's exclusive remedy for all claims of defects. If that remedy is adjudicated insufficient, Seller shall refund Buyer's paid price for the Goods and have no other liability to Buyer.

All warranty repairs must be performed at Seller's authorized service center using parts approved by Seller. Buyer shall pay costs of sending Goods to Seller on a warranty claim and Seller shall pay costs of returning Goods to Buyer. The turnaround time on repairs will usually be 30 working days or less. Seller accepts no added liability for additional days for repair or replacement.

If Seller offers technical support relating to the Goods, such support shall neither modify the warranty nor create an obligation of Seller. Buyer is not relying on Seller's skill or judgment to select Goods for Buyer's purposes. Seller's software, if included with Goods, is sold as is, and this warranty is inapplicable to such software.

SELLER DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Ordering Information

Product	Part Number	Description
EL640.480-AF1	996-0270-00LF	6.4" diagonal, 640x480 VGA display -5 to 55°C operating temperature, RoHS compliant
EL640.480-AF1 AG	996-0270-01LF	EL640.480-AF1 with anti-glare coating, RoHS compliant
EL640.480-AF1 ET	996-0270-05LF	EL640.480-AF1 with extended operating temp range, dimming, locking connector, RoHS compliant

Design and specifications are subject to change without notice.

Planar Systems continues to provide optional, and in many cases custom, features to address the specific customer requirements. Consult Planar Sales for pricing, lead time and minimum quantity requirements.

Support and Service

Planar Systems, Inc. is a US company based in Beaverton, Oregon and Espoo, Finland, with a world-wide sales distribution network. Full application engineering support and service are available to make the integration of Planar displays as simple and quick as possible for our customers.

RMA Procedure: For a *Returned Material Authorization* number, please contact Planar Systems, Inc. with the model number(s) and serial number(s). When returning goods for repair, please include a brief description of the problem, and mark the outside of the shipping container with the RMA number

European Union 2002/95/EC Directive on the Restriction of Hazardous Substances (RoHS)

In February 2003, the European Union issued Directive 2002/95/EC on the Restriction of Hazardous Substances, commonly known as RoHS, in certain electrical and electronic equipment. It restricts the use of six hazardous substances, including lead (Pb).

The Directive states that all new products placed on the European market after July 1, 2006 must be compliant with its requirements.

Planar Systems Inc. is fully in support of and compliant with EU Directive 2002/95/EC on all its products, except where exempted, such as medical. Should those exemptions be removed in the future, Planar will comply with such Directives or amendments.

A Planar part number will be modified with an “LF” suffix designation to indicate RoHS compliance, as shown on the part number label affixed to the display and on the box containing the display.

Planar Systems, Inc.

Customer Service

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